Mobile-subscriber equipment:
uninterruptible power supply vs. power inverter

by SFC David Gabhart

The 13th Signal Battalion of 1st Cavalry Division at Fort Hood, Texas, recently upgraded its node centers and large extension node to replace the current workstation computer, the AN / UYK-86 digital computer, with the new enhanced-switch operating system workstation. After we installed all systems, they went through a number of tests at Fort Hood's GTE regional support center. After we completed tests, 13th Signal Battalion deployed two upgraded NCs to the field and tested the equipment in a ramp-up exercise for a National Training Center rotation. We found some deficiencies in the upgrade and want to share our lessons-learned.

The new workstation is a vast improvement over the old UYK-86. The installed software is a Windows-type software with pull-down menus that appear to be much more user-friendly. Operators can use this software more effectively because many soldiers today have a working knowledge of Windows-based programs.

This system also has built-in diagnostics that allow the individual operator to identify a much broader range of technical problems. It's also equipped with technical manuals on both the hard drive and CD-ROM.

The new workstation uses 110-volt alternating current it receives from a power inverter with a 24-volt direct-current input and a 110-volt AC output. PI is a new piece of equipment that was installed in the switch as part of the upgrade. It was the source of many problems.

All components in the switching shelter use 24-volt DC power, so it makes sense to have PI also use DC power. If there's a loss of DC power in the shelter, PI stops producing the 110-volt AC necessary to operate the workstation.

The problems and surprises we encountered with the new PI included:

- The shelter lost DC power and the internal shelter batteries didn't hold, then PI stopped producing 110-volt AC. As a result, two things happened: the workstation lost power and the switch crashed. When you lose power to the workstation without going through the proper shutdown procedures, the possibility for software corruption exists and the time required to restart once power is restored is greatly increased.
- PI only comes with a one-year warranty. After that time, the unit must bear all costs of replacement, minus turn-in credit.
- PIs had a high failure rate. There were 22 PIs installed in various NCs and LENs across Fort Hood. Of those, there were eight failures within one month of fielding. That equates to a 36-percent failure rate. If PI fails, you've lost the workstation. There's still packet-switch and call-processing capability, but because the workstation software becomes corrupt during a switch crash, it can no longer communicate with the switch-processing unit. When this happens, you have to "crash" the entire system to bring it all back on-line again. This is an unacceptable situation that could cause major problems on the modern battlefield if commanders lose their command-and-control during a battle's critical point.

The problem with this inverter, though, gets worse.

The PI in question, NSN 6130-01-430-3116, costs $6,935. It's interesting to note the manufacturer, CTI, sells them under the production K022 contract for $2,160 each. GTE buys them from CTI and adds a handling charge before Communications-Electronics Command — who also adds a handling charge – receives them. This increases the total by $4,775. An average divisional Signal battalion requires seven PIs in the switches (assuming six NCs and one LEN) and two in the electronic-maintenance shop as spares. Therefore, with a 36-percent failure rate, you could reasonably expect two to fail during a deployment, costing the battalion $14,000 each time it deployed.

After much searching and testing, we found a solution. Bear in mind that previously with PI, when there was a power loss or PI failure, the workstation either lost data or became corrupt because of the power loss and inability to back out of the system properly. When that happened, it took an extremely long time to power back up, as we had to wait for a new load disk or take the switch all the way down to reinitialize.

CW3 Gregory Malfas, officer in charge of 13th Signal Battalion's electronic-maintenance shop, provided the solution. The answer was the ruggedized uninterruptible power supply, or UPS, NSN 6130-01-421-7678. UPS is a proven, reliable system, and it has many features not available in PI:

- It has a built-in battery back-up system.
- It has a dual-voltage input so it can take both 110-volt AC and 24-volt DC as its input, and it automatically detects whether AC or DC is present.
- It also has a fully isolated power output that's fully regulated, thus protecting it from power surges. It operates primarily on incoming AC power, which, if lost, will revert to DC input. If both are lost, it will resort to its internal back-up batteries. The UPS manufacturer states it can provide one kilowatt of internal back-up power for up to 10 minutes. Since the workstation uses

only 300 watts, you can expect the system to actually operate much longer than the 10 minutes advertised.

- It fits into the space in the shelter provided for PI.
- It costs less than PI. Initial cost for UPS is $4,365.
- The final and best advantage is it has a tremendous warranty. UPS has a life-of-contract warranty of 10 years. The contract was awarded in April 1995 and covers any UPS procured until 2005, so UPS we bought are under warranty for the next eight years. Some benefits this immediately brings to mind would be tremendous lifecycle cost savings; cheaper at the unit level; and proven track record, as it has been in the system for a few years.

To prove this was a better power supply, we put it to the test. Once we installed a test UPS in a switch, we dropped all DC power, crashing the switch and letting it stay off for 10 minutes. All this time, the workstation was up, operating off UPS' internal batteries. Once we brought the power back up, it took less than four minutes to have it back on-line. (Remember that in a normal switch crash with no data corruption, it takes 20 to 30 minutes for a switch operator to bring it back on-line.) We did this test in one of our NCs with an average operator, and he didn't have to rely on support from either the electronics-maintenance shop or a higher-echelon maintenance technician.

After the test was successfully completed, 13th Signal Battalion installed UPS in all our switches. With UPS, your workstation never goes off, so you're still at the less-than-five-minutes window for being back on-line, thus providing maneuver units in your area of responsibility with reliable, quality communications.

GTE and PI's manufacturer, CTI, have taken steps to correct the PI problems. GTE and CTI conducted a thorough analysis of the high failure rate's cause. The analysis' result was that all PIs in stock were modified in an effort to prevent

Figure 35. PFC Thomas Schnell of Company A works in a node center with one of the new UPS installed.

the problems I've described. New units being fielded will get the modified PIs, and those already fielded will get modified ones as old ones are turned in for repair.

GTE pointed out the reason PI was chosen over UPS was the initial price from CTI for the inverter. That may be a good deal for GTE, but once the $4,775 markup hits the Army, the unit loses. GTE and the ESOP team also said that if your inner-shelter batteries are working properly, you'll have time to shut down the system properly in the event of a power failure. That's true, but the reality in the field is that system batteries do fail, so having a more reliable system in place would bring higher reliability and peace of mind.

In summary, there are a few reasons UPS is the answer to enhancing your recent ESOP upgrade. First and foremost, it's more reliable than PI. Second, it costs less and comes with a longer warranty. Third and perhaps most important, you can recover a switch in less than five minutes, where it could have taken 20 to 30 minutes (or longer) before if there was data loss when the workstation crashed with the switch.

Lastly, we're in the business of providing warfighters with rapid, reliable communications. With UPS on board, it greatly increases our ability to do that. The bottom line from a combat commander's perspective is that if he can't communicate, he can't control his troops, bringing critical combat power to a decision point at the right time and right place.

The installation procedures for UPS are quite simple. Follow these guidelines and you shouldn't encounter any difficulties:

- Remove all cables connected to the power inverter;
- Remove the power inverter;
- Remove the brackets attached to the power inverter and save all hardware;
- Place UPS in the same position as the power inverter. Center it so the brackets can be installed. We suggest you place the brackets with the long-slot side down;
- Secure the brackets to UPS. You may have to widen the hole in the bracket so it lines up with UPS;
- Drill into the stand to secure the bracket to the stand;
- Using a tap and die set, tap the stand with the appropriate size. Then secure with a machine screw. You may secure the machine screw with a nut;
- Connect all cables (DC power, AC output to work station);
- Lengthen the AC input cable that comes with UPS by six feet. You need to use at least 10-gauge wire when lengthening the power cable;
- Connect the black lead to the hot side of the battery charger's circuit breaker; and
- Connect the ground and return to the shelter's ground bus.

You're done. All power-up procedures can be found in UPS' technical manual, TM 11-6130-486-12&P.

SFC Gabhart was noncommissioned officer in charge and platoon sergeant of 13th Signal Battalion's electronic-maintenance shop from September 1995 until October 1997. He has since been assigned to Personnel Command's Enlisted Personnel Management Division, ordnance branch, in the Military District of Washington.

Acronym Quick-scan

AC – alternating current
DC – direct current
ESOP – enhanced-switch operating system
LEN – large extension node
NC – node center
PI – power inverter
TM – technical manual
UPS – uninterruptible power supply